Dynamic Image Process Method for Vegetation Indexes in Precision Agriculture

Precision Agriculture Association New Zealand
PA17 - The International Tri-Conference for Precision Agriculture in 2017
• 7th Asian-Australasian Conference on Precision Agriculture
• 1st Asian-Australasian Conference on precision Pastures and Livestock Farming
• Digital-Farmer and Grower 2017
November 15-18 2017
Hamilton, New Zealand

Kyung-Suk Oh [1], Hyun Kwon Noh [1]*

[1] Department of Biosystems Engineering, Chungbuk National University, Cheongju, Korea
Tel: +82-43-261-2581, email: nhkisg@cbnu.ac.kr

INTRODUCTION

- The concept of precision agriculture was established in the 1960's. However, it was very difficult at that time to practice precision farming because of the lack of appropriate electronics and computers.
- Currently, aerial images, tissue analyses, soil sampling analyses, and soil plant analysis development (SPAD) readings are used to assess the crop nutrition status.
- The remote sensing techniques are very popular and used in many areas including PA in these days.
- But in the case of remote sensing which uses passive light system, the image data should be processed for vegetation index in PA

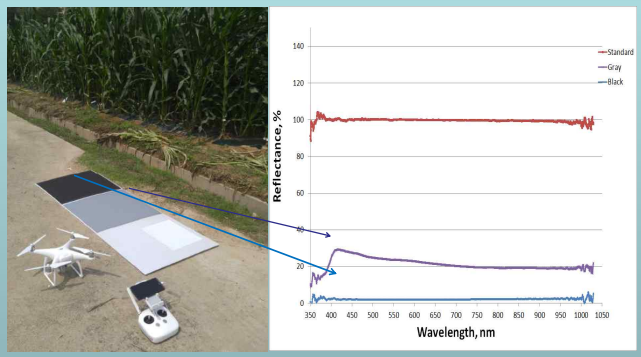
OBJECTIVES

- This paper presents the dynamic calibration image processing method(independent of ambient light condition) of a CMOS image sensor, which uses three channels (green, red, blue) of crop images to determine crop reflectance for vegetation index.

METHODS AND PROCEDURE

Crop image acquisition system using a Phantom 4 drone

- The real-time crop image was acquired using CMOS image sensor(Phantom 4, China). The crop images were acquired during a different light condition from sunny to cloudy.



(a) (b)

Figure 1. Image acquisition system using Phantom4 drone and reference reflectance panels for dynamic calibration (a) and reflectance of reference panels (b)

Measurement of reflectance of reference panel

- For measuring the reflectance of reference panel, the Ocean Optic system was used.
- Figure 2 shows the schematic of the active measurement system of reflectance for reference panel. This reflectance measuring system includes high resolution spectrometer, reflectance probe, light source, and lap top(Ocean Optic software) computer.
- The reflectance of reference panels were displayed in Fig. 1. (b). Calculating from the graph, the reflectance of reference grey and black panel were 20% and 2% respectively. The white panel reflectance was removed from the graph because of the saturation.

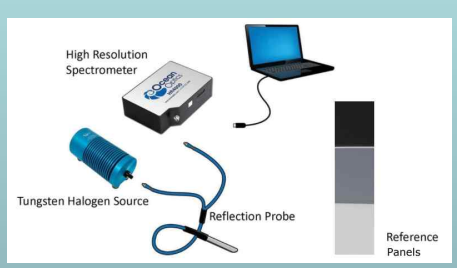


Figure 2. Reflectance measuring system(Ocean Optic) and reference panels

Dynamic calibration using a known reflectance reference panel

- Dynamic calibrations were investigated for a true reflectance calculation by using a known reflectance reference panel.
- The background elimination algorithm and the crop canopy reflectance analysis algorithm were also used for this researh

RESULTS

Dynamic calibration using known reflectance panels

- To eliminate the effect of ambient illumination variation on grey levels of crop image caused by either the clouds or the solar radiation angle, the dynamic calibration model calibrates the measured crop reflectance (Fig.3).

a) Sunny b) Cloudy

Figure 3. Acquired crop image according to light condition

Table 1. Pixel value of reference panel according to light condition

Sunny	Red	Green	Blue
Gray	210	222	253
Black	78	72	98
Cloudy	**Red**	**Green**	**Blue**
Gray	178	191	234
Black	60	58	79

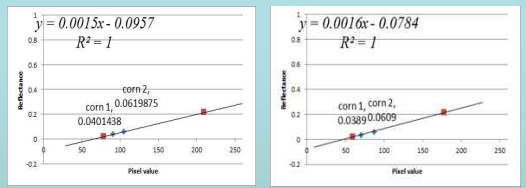


Figure 4. Reflectance of corn leaves in red channel according to light condition((left)sunny, (right)cloudy) with a dynamic calibration

- The core of this investigation is the calibration methods between the CMOS image and the reflectance in crops.
- Some noticeable relationships between the CMOS image reflectance and light condition were found from this study. The error of reflectance using dynamic calibration method were less than 3% meanwhile the error of pixel value in corn were more than 17%.

Table 2. Reflectance and pixel value of corn leaves according to light condition

Red	Sunny (%, const)	Cloudy (%, const)	Error
Corn 1 (Ref., Pixel value)	4.01%, 91	3.89%, 71	2.9%, 22%
Corn 2 (Ref., Pixel value)	6.20%, 105	6.09%, 87	1.8%, 17%

CONCLUSIONS

- The developed dynamic calibration model can be used to compensate for the variation of ambient light caused either by the weather condition or the solar zenith angle effectively.
- The CMOS image sensor is capable of detecting crop reflectance reliably in real-time by using a dynamic calibration.